Exploring the Evolution of Engineering Doctoral Students' Academic and Career Goals in the First Year of Graduate School

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ABSTRACT

The purpose of this full research paper is to explore how first-year engineering graduate students' goals change over the course of their first academic year in their graduate programs. While existing literature indicates that the first year of graduate school can be challenging, it is critical to student socialization as they become familiar with the expectations of their discipline and research domain. Individual goal setting is also very important to overall academic and career success during this time. However, it is unclear what goals engineering graduate students have when entering their programs or how socialization may shape those goals. This study uses the theoretical framework of Future-Time Perspective, specifically the extension component, to explore what n=4 first-year engineering graduate students' initial goals were when entering their graduate programs and how those goals may have evolved over the course of their first year. In this longitudinal qualitative study, we interviewed the participants four times throughout the course of their first academic year: (1) during the first semester, (2) between the first and second semesters, (3) after the second semester, and (4) at the end of the first summer of graduate school. Using thematic trajectory analysis, we determined what students' goals were at the start of grad school and how they may have changed. Findings indicate that students' goal extensions fluctuated throughout the year and ultimately became more short-term by the end of the first year. Participants found it difficult to extend their goals because graduation was so far away and there were few opportunities for reflection within their programs. Implications from this work will help students, faculty, and administrators begin conversations about student goals and encourage students to engage in reflective practices to determine the value of the doctoral degree for them along with whether their courses and research align with their goals.

INTRODUCTION & LITERATURE REVIEW

Attrition is high in engineering graduate programs. The 10-year completion rate for engineering PhDs is only 60% depending on the discipline [1], with attrition rates at approximately 35% for women, 24% for men, and as high as 57% for African American engineering graduate students [2]. As many as 70% of students that remain enrolled in engineering programs consider leaving their degrees in any given month [3] for a myriad of reasons including microaggressions and racism [4]–[7], chronic stress [8]–[11], a variety of costs [12]–[15], and feeling disenchanted and disinterested in academia [16], [17]. Students who have clear goals in graduate school, however, are better able to navigate these negative experiences because their goals can increase their performance and overall motivation [18] and remind them why they are persisting when faced with adversity or challenging situations [19]–[21]. To better support engineering graduate students throughout their time in graduate school, it is important for researchers to understand students' goals. Because students can become disenchanted as they progress through their degrees, the exploration of students' goals must start from their first year in graduate school to establish a baseline understanding of what motivates them to be in graduate school. As such, this paper explores first-year engineering PhD students' goals throughout the first year of graduate school.

Goals are people's desired outcomes and represent what individuals want to achieve within a specific timeframe [22]. They can be short- or long-term. Short-term goals are completed within 6 months to 3 years while long-term goals span 3-5 years or beyond [23]. Oftentimes, goals are either personal (i.e. building healthy habits, developing new hobbies, socializing) or professional (i.e. progressing careers, enhancing skills, completing work tasks). Much of the engineering student goal literature is at the undergraduate level. This body of work tends to focus on undergraduate engineering students' career goals. Researchers have studied the relationships between students' future career goals and motivation to learn and persist through [24]–[27], continued interest in their engineering major [28], career goal commitment after graduation [29], and engineering self-efficacy [30], [31]. In their exploration of what factors motivate undergraduate students to enroll in engineering graduate programs, Borrego et al., [32] and Kyoung Ro et al., [33] found that career goals can predict enrollment. In one of the only longitudinal studies, McGough et al., [34] explored students' perceptions of their future career goals over one academic year, finding that students' goals change throughout the year, becoming more or less defined over time.

At the graduate level, however, less literature exists related to students' goals. Some researchers have studied how students' future career goals motivate students and influence their perceptions of how useful current tasks are [35], [36]. Sallai et al., [37] found that engineering master's and doctoral students attributed some of their persistence in their graduate programs to career goals. In another study, Amelink and Artiles [38] explored how graduate school experiences can shape racially marginalized students' career goals, finding that industry connections and internships can help students clarify their career goals. Much of the graduate student goal literature centers on attrition. Students who enter engineering graduate programs with unclear goals consider attrition more often [39] and changes in goals throughout graduate school can lead to attrition [15], [40], [41]. These changes in career goals can come from a variety of experiences throughout the graduate degree, including experiencing critical and negative events in the degree program [42]. Overall, the literature on engineering graduate student goals emphasizes how students' career goals form or affect their experiences in their programs. However, there is limited research on what these students' goals actually are and whether they go beyond career aspirations. There is also limited discussion of students' goals at different time points throughout the graduate degree as we know that socialization shapes students' experiences [43]–[47]. Therefore, this study seeks to explore the following research question:

> What are first-year engineering graduate students' personal and professional goals and to what extent do they evolve throughout the course of their first academic year?

THEORETICAL FRAMEWORK

Because goals are fundamentally future-oriented, a future-oriented motivational theory is necessary to explore our research question. Future-Time Perspective (FTP), which explores how people's future goals relate to their actions in the present [48], [49], provides the theoretical framework for this study. This theory has been applied in both undergraduate [26]–[28] and graduate-level [35], [36], [50] research to understand students' academic motivations, role identity, and career goals among other things. FTP contains many components including how much a person connects the present and future, the perceived instrumentality of someone's present action for their future goals, directionality which relates to a person's perception that they are moving forward into

the future, speed which is a person's ability to plan for the future, and extension which relates to how far into the future a person sets their goals [51], [52]. These components (connection, perceived instrumentality, directionality, speed, and extension) all work to contribute to an understanding of how a person relates their present to their future within the FTP theoretical approach. In this study, we focus on the extension component of FTP. Previous research studies have explored the extension of engineering undergraduate students' career goals to better understand academic performance and motivation [25], [28]. This work specifically applies extension to the context of engineering doctoral education, exploring the personal and professional goals of engineering graduate students and how these goals may extend into the future.

METHODS

In this work, we seek to understand first-year engineering graduate students' goals when entering their programs and the extent to which these goals evolve throughout the first year of graduate school. To carry out this research, we conducted a longitudinal qualitative study to explore participants' experiences in their first year. We purposefully sampled previously recruited participants from a related IRB-approved study for this work. More information on the related study can be found in [53], [54].

Recruitment and Participants

Participants of this study were a subset of previously recruited participants from a related IRB-approved, NSF-funded study [54]. To recruit participants, we emailed the available department heads and graduate student coordinators of all engineering departments at the top 50 engineering PhD-granting universities in the United States as per ASEE's 2020 Engineering by the Numbers [55]. In the email distributed in the Fall of 2022, we asked faculty and administrators to share our Qualtrics recruitment survey and a description of our overall research objective to understand graduate student experiences to their master's and PhD student listservs. The recruitment survey included demographic questions related to engineering discipline, number of years in graduate school, gender, and race/ethnicity. Students were also asked why they enrolled in and were persisting through their graduate programs (for results of this work refer to [54]).

Participants for this study were purposefully sampled from the 1,084 engineering graduate students who completed the initial nationwide recruitment survey. Four criteria factored into the selection of participants for this work: year in graduate school, discipline, citizenship, and reasons for enrolling in graduate school. Only students who were in their first year of a doctoral engineering program were considered for this study, as that was the scope of the research question. We controlled for disciplinary context and selected only those students who were enrolled in mechanical, electrical, or civil engineering programs as literature indicates there are disciplinary differences in socialization and employability even within engineering [41], [56], [57]. These three disciplines were selected because they are the three original branches of engineering and students within these disciplines can find employment without a graduate degree. This work necessitated an exclusion of international students because visa requirements can influence their experiences and goals while enrolled in school [58]. In the initial recruitment survey, students were able to select from over 20 choices of reasons to enroll in graduate school. Students who selected multiple reasons for enrolling in graduate school were considered for this study as they appeared to have

multifaceted motivations drawing them to pursue a higher degree that could later influence their persistence in their programs.

Students who met all criteria were then emailed to inform them that they would not be selected to participate in the related study and instead could choose to participate in this study. In the email, we included information related to this longitudinal study. Of the 20 students who were considered for this study, n=4 first year engineering graduate students agreed to participate. Demographic information for each participant can be found in Table 1. Participants' engineering discipline is not included in this table because it was only considered in the initial recruitment process, it was not an influential factor in this work, and to decrease the amount of unnecessary identifying information that is publicly shared.

Table 1. Participant demographics including chosen pseudonym, gender, and race/ethnicity.

Participant Pseudonym	**Gender**	**Race/Ethnicity**
Milo	Woman	Hispanic/Latinx
Mark Lankenau	Man	White
Tasha	Woman	White
Lucas	Man	Asian

Data collection and analysis

Due to the longitudinal nature of this study, each participant was interviewed four times. The first interview occurred in the Fall of 2022 during participants' first semester of graduate school. The second interview occurred between the first and second semester. The third interview occurred in the Spring of 2023 at the end of participants' second semester of graduate school. The final interview occurred at the end of the summer. A semi-structured interview protocol was used for each interview to encourage participants to share experiences that were salient to them and allow for follow-up questions. In each interview, participants were asked about a variety of facets related to their experiences in their graduate programs, including their relationships with their advisors and lab mates, research progress, coursework, support networks, and personal and professional goals. Because participants were recruited from a nationwide survey, all interviews were conducted via Zoom. Interviews lasted between 90 and 120 minutes and participants were compensated after the second and fourth interviews with $10 and $20 Amazon gift cards, respectively. Audio recordings of the interviews were sent to a secure transcription service and any identifying information was removed. Participants were encouraged to select their own pseudonyms after the first interview.

There were multiple stages of qualitative data analysis because of the longitudinal design of the study. Content analysis was used after the first, second, and third interviews to identify participants' personal and professional goals. Results of these analyses informed the interview questions related to goals for each of the following interviews. For example, a participant who described work-life balance personal goals in interview 1 was also asked about their personal goals in interview 2 and asked why those goals may have shifted if their response was different from the previous interview.

After the final interview, the authors conducted a thematic trajectory analysis (TTA) [59] to explore participants' personal and professional goal extension along the first year of graduate school. This data analysis method, which has largely been used in diary entry research, is suitable

for longitudinal qualitative research as it is temporally sensitive. TTA visualizes participant data, which allows researchers to explore potential thematic changes within and between participants. To conduct TTA, the authors followed the four-step approach outlined by Spencer et al., [59]. First, data display matrices were created for each participant. These matrices order participants' raw data temporally for ease of analysis in the following steps of TTA. Next, these matrices of raw data were thematically analyzed. In this step, the authors coded participants' personal and professional goals through the lens of the FTP extension component to understand how far into the future participants' goals extended. A priori codes were developed based on the definitions of short- and long-term goals and higher education's ubiquitous semesterly cycles to describe goal extension. Participant goal extension was coded as semester (approximately 3-6 month extension), 1-3 year, 4-5 year, and beyond graduate school extension. Step 3 of TTA involved the visualization of results from the thematic analysis see Figures 1 and 2 in Findings) to show the extension of personal and professional goals for each participant at the different interview timepoints. Finally, these figures were used to explore within and between participant patterns of goal extension in the final step of TTA.

Limitations

This study, like all others, has limitations that must be acknowledged. The longitudinal design of this study could have affected invited students' desire to participate in this research because of the perception of high commitment. This may have led to self-elimination and could limit the participant experiences captured in the study because there may have been students with unique experiences who did not participate. The small sample size may limit the understanding of the types of goals and evolution of goals first-year students experience. The under and lack of representation of students with certain marginalized racial/ethnic or gender identities may also limit our understanding of students' goals and goal evolution. The absence of international first-year engineering graduate students, while intentional, is an inherent limitation because those students' goals and experiences are not discussed. Choosing participants in only three engineering disciplines can also limit the breadth of experiences and goals of engineering graduate students.

FINDINGS

In this section, we describe participants' personal and professional goals. First, we explore the participants' personal goals at four points throughout their first year in their engineering graduate programs. Then, we explore their professional goals at those same timepoints. Because the extension component of Future-Time Perspective provides the theoretical underpinning for this work, we have also used thematic trajectory analysis to visualize participants' extension of personal and professional goals in Figures 1 and 2.

Personal Goals

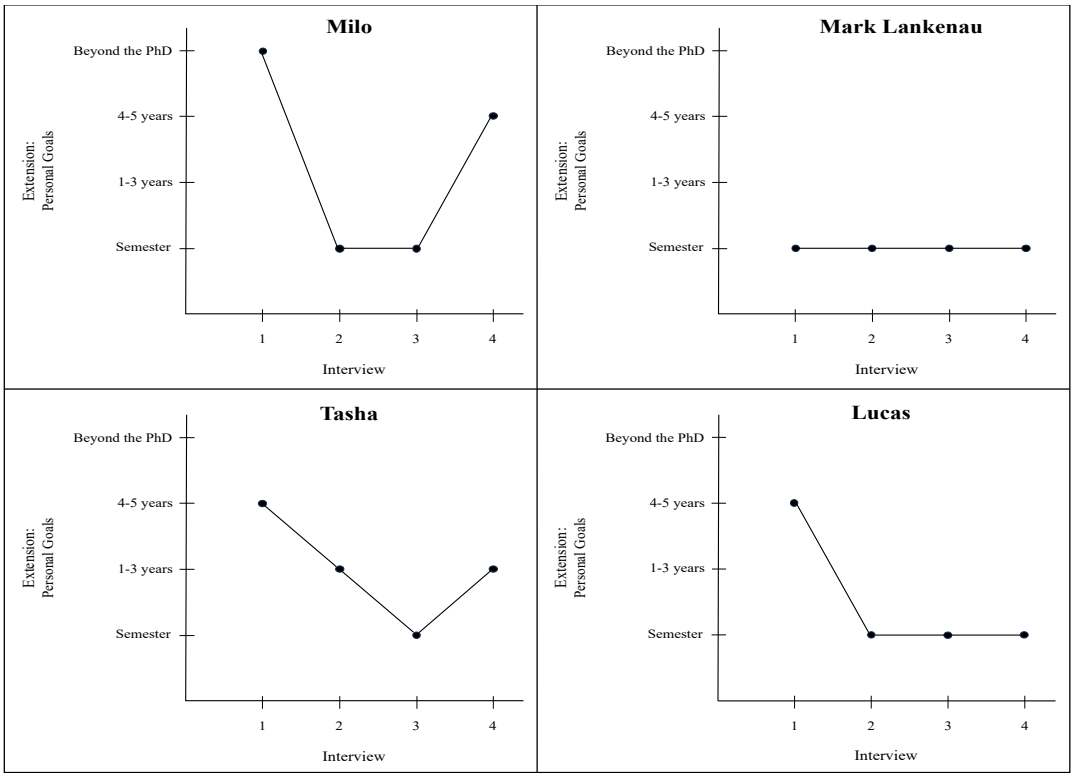

Figure 1. Thematic trajectory analysis of personal goal extensions at each of the four interviews for the n=4 participants.

Figure 1 provides each participant's personal goal extension at four timepoints in the first year of graduate school. Although the participants described many personal goals, establishing and maintaining friendships and other relationships and work-life balance were central personal goals throughout all four timepoints of the first academic year. From Figure 1, we note that three of the four participants had longer-term (4 or more years) personal goals in that first semester of graduate school when the first interview was conducted. In her first interview, Tasha, for example, articulated her personal goals. She explained that she wanted to learn how to prioritize what work got done first in long to-do lists and was also hoping to grow her support network and grow as a person by the time she finished graduate school.

> "…like the more abstract, like prioritization.. like how you choose what is actually the most important thing to work on a particular day. And like if you have competing priorities, like how do you assess, like what is really going to like drive your research forward… so that's something I guess pretty specific that I'm hoping to grow in grad school in that way.... Like make friends, grow as a person.." – *Tasha, Interview 1*

As the first year progressed, however, participants' personal goals became less extended, centering around semesterly personal goals. For example, Lucas's personal goals became less future-oriented after the first semester. Throughout the first year, his main personal goal was to maintain work-life balance, including healthy eating and regular exercise. After that 1st interview, Lucas began thinking of his personal goals as something to accomplish within the semester timeframe. As early as his 2nd interview, he was thinking of his personal goals in semesterly chunks.

"Personal goals... I guess just exercise regularly… just get through the semester.." – *Lucas, Interview 2*

While participants' personal goals remained consistent during the first year of graduate school, how far into the future they were setting these goals decreased as they progressed through the academic year. Milo and Tasha did increase their extension of personal goals after the first summer of graduate school, but not to the same distance as when they had started their graduate programs. Overall, participants' personal goals extended less by the end of the first year.

Professional Goals

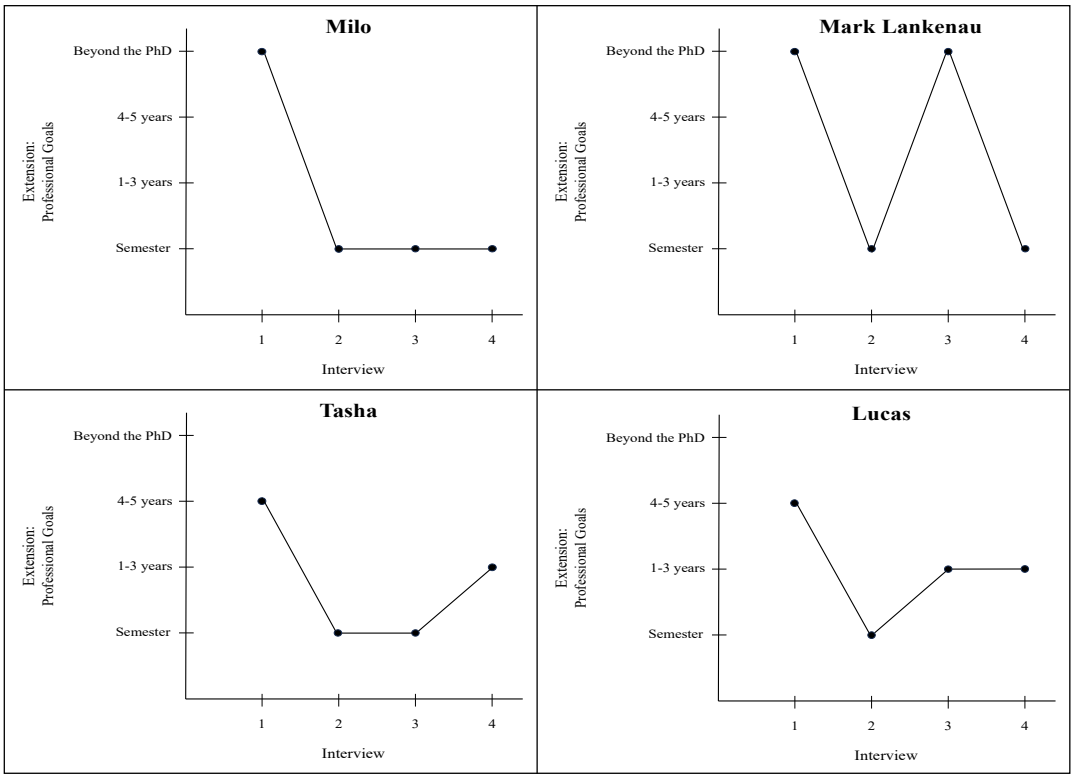

Figure 2. Thematic trajectory analysis of professional goal extensions at each of the four interviews for the n=4 participants.

Figure 2 provides each participant's professional goal extension at four timepoints in the first year of graduate school. While all four participants' professional goals extended beyond 4 years in the first semester of their graduate programs, the goals themselves differed slightly. Milo and Lucas were singularly focused on obtaining their PhDs, with both participants explicitly describing getting the PhD as their professional goal when asked.

"Do [the PhD] and do it well." – *Milo, Interview 1*

Tasha and Mark Lankenau's professional goals went beyond obtaining a PhD. They also wanted to become experts in their fields. Tasha specifically wanted to gain a deeper understanding of her research topic to be able to contribute to society. Mark Lankenau, on the other hand, wanted

to be able to answer others' questions or figure out answers to people's questions when the answers were not easily found.

> "… It's a two-fold goal of get that degree but also be a master of the field, understand the field enough that you could explain at least a majority of what's going on. And enough to say like I don't know exactly what's going on but I know how to find out what's going on." – *Mark Lankenau, Interview 1*

As the participants progressed through the first year of graduate school, however, professional goals became less extended. Their professional goals began to evolve as early as the beginning of their second semester during Interview 2. In this interview, all four participants described their professional goals in some variation of making it through the upcoming semester, whether that was by making research progress, successfully TA-ing, or just metaphorically putting their heads down and getting through their courses. Tasha explained why it was difficult for her to set professional goals that extended beyond the semester timeline, emphasizing how challenging it was to think about anything beyond the looming semester.

> "Yeah, it feels like a challenging circumstance in which to really have like kind of stretch professional goals. I feel like the thing that I need to do is just do the things that are in front of me and figure out how to do them well and that will set me up the best to do more in future years." – *Tasha, Interview 2*

As the participants entered the summer in Interview 3, both Lucas and Mark Lankenau's professional goals extended beyond the semester timeframes. Mark, in particular, was focused on professional goals that extended beyond graduate school and included figuring out employment opportunities he could readily translate his skill set to after he finished his degree. Although Lucas's professional goals continued to center around accomplishing tasks for his degree, he was thinking further into the future into the next year instead of just the next semester, specifically hoping to publish his research in the upcoming year. It was only after the summer had passed and she was getting ready for the new academic year in Interview 4 that Tasha's professional goals extended beyond the semester time point. Like Lucas, she remained focused on goals related to her degree but was thinking in terms of one to two years from now. Tasha hoped to improve her research communication skills through presentations and publications and prepare for and pass her qualifying exam. By the end of the summer as the participants were preparing for their second year in graduate school during Interview 4, however, none of their professional goals extended beyond a couple of years. All the participants' professional goals centered around one of three areas in Interview 4: research progress, coursework, or TA-ing. Over the course of the year, their goals evolved into being specifically about what needed to be accomplished to feel like they were progressing through their PhDs. Tasha was asked why her goals had evolved and did not extend as far out as they had before. In her response, she explained that long-term goals required reflection which she could not do in her academic environment.

> "I do think that grad school in general, any environment where you're very busy, is going to push you to think more about your short-term goals and what's happening next? What do I need to do to get through the semester, get through the year. Yeah, it definitely takes away from your ability to think long-term and big picture... I think just because that kind

> of reflection... Because to set a long-term goal, it's hard to just pull it out of your ass, you have to really contemplate and reflect and think about what you want out of life and what your real deficiencies are and what you need to change going forward, and I think that being in an environment where you're constantly just working on the next thing, you need to have time… if you're gonna do that kind of deep reflection, you need to have time for it, and if you're constantly super busy, then you just don't have time for it." – *Tasha, Interview 4*

Tasha explained how the demanding graduate school environment of always working towards the next thing and the publish or perish mentality were not conducive to reflection. This lack of space, time, and encouragement to reflect made it difficult for her to think beyond the next task on the to-do list. Overall, the participants' professional goals extended less by the time they completed their first year than they had when they were starting their degrees.

Career Goals

Participants' career goal extensions are not visualized here because they extended beyond graduate school at all time points and are usually part of people's professional goals. While career goals are generally encompassed in professional goals, the participants in this study did not often associate them together. With the exception of Mark Lankenau who spoke of his career goals early and often, the participants had to be prompted to discuss any specific career goals. All four participants enrolled in their PhD programs to further their careers. Milo, for example, had switched careers shortly before enrolling in her PhD program. She was originally working in a technical engineering role that she found unfulfilling and decided to pivot into a research career in another engineering field. She enjoyed lab work and research so much that she decided to obtain a PhD so that she would receive what she felt was fair compensation for the research skills she already felt she had without the PhD.

> "So I'd like to have a position where I do research on a daily basis… I mean, [a PhD] is needed for the type of job that I want to get. And I would actually be compensated how I should be compensated for just doing research…" – *Milo, Interview 1*

Lucas had a similar experience with an unfulfilling job. He wanted to work on more innovative projects and have more independence so he decided to obtain a PhD to have the credentials to be hired for roles that could satisfy those desires and change his working environment. For Tasha, the PhD was an unspoken requirement in her desired industry. She knew she would not be taken seriously as a consultant without a degree that qualified her as an expert in the field. Mark Lankenau was the only participant whose career goal was a non-industry sector. He knew he wanted to go into academia to teach at the undergraduate level and believed the PhD was necessary to achieve that goal.

> "kinda the goal for graduate school for me was to have a degree that would allow me to teach at the undergraduate level… I think that, in general, it's important that the person teaching a class has a deeper knowledge than the content that they're teaching. So I shouldn't be able to show up to the class, read the lecture and consider that teaching. I should be able to answer questions that are beyond the surface level of the content that is

> expected of the students. And I think that that sort of experience for a professor it tends to lead to better discussions and richer learning experiences for the students in the classroom. So I do think that the PhD is a necessary." – *Mark Lankenau, Interview 1*

Tasha and Lucas's career goals changed minimally throughout the first year of graduate school. Tasha remained interested in becoming a consultant but broadened the consulting sectors she was considered to include both private and government consulting. Meanwhile, Lucas narrowed the scope of the industry sector he wanted to work in. He knew he wanted to work in research and development and decided he would apply to national laboratories when it was time to find a job. Milo and Mark Lankenau's career goals, however, evolved as they progressed through the first year of graduate school. For both participants, this evolution was a result of a critical event in their first year. Milo participated in a summer internship that exposed her to private sector research and development work. During this internship, she learned about different ways to conduct research in industry environments. This opportunity showed her alternative career paths and by the end of the summer in Interview 4, she was trying to determine which path she wanted to take.

> "… I feel like [the internship] was good exposure to see what's out there in terms of jobs. I don't think I would want to own my own lab like I don't… I think I'd like to stay more technical. But at the same time, I also don't wanna be stuck in the lab throughout like much later on in life. So I'm trying to see.. I think another part of what I'm doing like more data engineering, data science. I feel like that is definitely more of a draw for me now." – *Milo, Interview 4*

Mark Lankenau's career goal shift was prompted by a challenging class in the Spring semester where questions arose about the origins of classroom data, it's interpretation, and why it mattered. He felt that his professor, who had gone straight from their PhD to academia, was uninterested in understanding this data beyond knowing that it was data that was necessary for an assignment. Mark Lankenau was unsatisfied with the professor's responses to his questions and believed the problem was that the professor had not been exposed to industry before teaching students. He subsequently decided that he would go into the industry sector for 10-15 years before going back to academia to be a teaching professor because this would help him gain experience to properly answer students' questions.

> "[My career] would definitely be in either a design consulting field or, potentially like professional grade just research. But definitely in that field, not in academia yet. Because I feel that it's very important, and this is something that I continued to notice this semester actually. I think it's very important since I want to eventually teach, to be able to bring in real world applications to things. I had a professor this semester who has been in academia [their] entire career, has never worked in the field. And we were talking about a data set and [they] blatantly said like, "I have no idea where this data comes from. I don't understand how it comes to be, but this is just the data that I work with." And that bothered me to no end because I was like, what am I actually looking at? These are just numbers to me if I don't know what they mean. So that's something that I aspire to have reasonable decent amount of real-world experience before entering a teaching career, so that I can actually inform students of what the field would be." – *Mark Lankenau, Interview 3*

Overall, all four participants enrolled in their doctoral programs because a PhD would help them achieve their career goals. As the participants progressed through their first year, their career goals shifted and evolved, becoming more defined.

DISCUSSION & IMPLICATIONS

In this longitudinal study, we explored 4 first-year engineering graduate students' personal and professional goals and the extent to which those goals evolved in the first academic year of graduate school using the extension component of Future-Time Perspective. Results indicate that participants' personal goals centered around developing work-life balance and maintaining platonic and romantic relationships. Professional goals related to PhD tasks including coursework, progressing research, successfully TA-ing, and learning. The participants' career goals included research and development, consulting, and teaching. This study offers many discussion points, including that participants' career goals were not considered in discussions of professional goals and were reevaluated based on their experiences throughout the first year and that both their personal and professional goal extensions changed in the first year of graduate school.

When the topic of professional goals is brought up, career goals are often part of the discussion as they are often assumed to be a subtheme within the larger professional goals. When we asked participants to describe their professional goals in this work, we also assumed that career goals would be shared due to this connection. However, this connection between professional and career goals was not evident in our interviews. Participants only discussed their career goals after being prompted with a follow-up question about what their career goals explicitly were. Although previous research suggests that engineering doctoral students are motivated by and mindful of their career goals [35], we found that three of the four participants were not actively thinking about their career goals. In further discussions, the participants explained that their careers seemed so distant in the future that it did not make sense for them to seriously consider career goals as first-year students.

Although the participants were not hyper-focused on their career goals throughout the interviews, they did experience changes in these goals. As they became more socialized in academia, they experienced academic disenchantment [16], [17]. Mark Lankenau and Tasha disagreed with some of the mainstream teaching and hierarchical practices entrenched in academia, which prompted them to shift their career goals away from academia. Experiencing both positive and negative critical events also contributed to changes in career goals. Milo's internship experience over the summer encouraged her to consider alternative careers and expand her career goals while Mark Lankenau's negative learning experience pushed him towards industry. These findings support previous literature on how critical events can shape graduate school experiences [42] and how graduate school experiences can clarify career goals [38].

In FTP, extension refers to how far into the future individuals set their goals. In this study, we found that participants' personal and professional goal extensions changed throughout the first year of graduate school. Most of the participants began graduate school with long-term personal and professional goals that extended beyond 4 years. After they completed their first semester, however, their goal extension significantly decreased. They became semester-oriented, describing personal and professional goals that were short-term to be accomplished within the 4-month period generally associated with semesters. Personal goal extension remained short-term for participants as they began their first summer as doctoral students. For Lucas and Mark Lankenau, however, professional goals became more extended at the start of the summer. The end of the summer and

subsequent start of the second academic year brought on an extension of personal goals for Tasha. Both Tasha and Milo experienced extensions in their professional goals as the summer was ending. Mark Lankenau, on the other hand, became semester-oriented again at the end of the summer with professional goals that did not extend beyond the upcoming Fall semester.

The participants' personal and professional goal extensions fluctuated throughout their first academic year as engineering doctoral students. By the end of their first year, however, neither their personal nor their professional goals extended as far into the future as they had when the participants were first beginning their graduate degrees. Participants attributed this decreased extension to two things. Extending goals beyond 1-2 years was a waste of time and energy for some participants because they had many more years before the end of their PhDs. They wanted to put their heads down and focus on the next milestone, in many of their cases qualifying exams, to then be one step closer to finishing. For other participants, it was just too difficult to think long-term. Tasha explained that setting long-term goals required her to reflect on what she wanted and needed, and she did not have time to do that while still accomplishing everything she needed to for her degree. Other participants agreed that reflection was difficult in graduate school with all the time constraints and emphasis on productivity. They also believed that faculty and their graduate programs did not value reflection as it was not encouraged or promoted.

Decreasing goal extensions in the first year of graduate school are concerning for engineering graduate education. Students shifting into semester-oriented goal extension is akin to entering a form of survival mode specific to academia. This mindset has negative consequences for faculty and administrators trying to mentor students and for the students themselves. When students enter this survival mode, it is difficult for them to figure out what skills they ultimately want to develop and enhance during their PhD. This can lead to uncertainty of goals, which is a factor that contributes to attrition [15]. It can also lead to struggles to remain motivated during stressful experiences or milestones in the degree or devaluing of the doctoral degree for the students who can no longer identify the benefits of it. This also affects the faculty and administrators who mentor these graduate students as students' unclear or limited goals challenge their ability to provide proper guidance for students to build skills for the future.

The negative association between graduate engineering programs and reflective practice hinders graduate students' ability to set personal and professional goals with long extensions that can enhance their graduate school experience and faculty mentorship. Graduate departments can ease this negative association by encouraging students and faculty to engage in reflective practices related to goal setting and the value of an engineering doctoral degree. Faculty can ask students questions like what they hope to accomplish by the time they graduate or what can a PhD do for them. Coming back to these questions and the responses associated with them every semester allows students to be reflective more often and maintains open communication within the advisor-advisee relationship. It can also gently shift students out of the survival mindset they may enter at the start of every semester. Future work should explore graduate students' extension of personal and professional goals at other stages of the PhD and the application of reflective practice in graduate engineering departments to understand the value students may place on the degree and how their motivation may change with these practices.

CONCLUSION

In this longitudinal study, we explored first-year engineering graduate students' personal and professional goals. Guided by the extension component of Future-Time Perspective, we also

explored how those goals evolved and extended into the future throughout the academic year. Findings indicate that students' personal goals center around establishing work-life balance and maintaining romantic relationships and friendships. Professional goals center around accomplishing tasks relevant to the doctoral degree including coursework, research progress, and TA responsibilities while career goals range from teaching to consulting to research and development. Both personal and professional goal extensions fluctuated throughout the first year but ultimately became less extended by the end of the year than they were at enrollment. This change in extension relates to lack of time and encouragement for reflection on goals in engineering graduate programs. Future work should explore how reflective practice affects goal development and extension and the extension of personal and professional goals for graduate students at other stages of the PhD.

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